

IES Newsletter

Volume 11, Number 5
September - October 1994

Director's Note

The summer months find the Institute's scientists doing field work at sites across the Arboretum and elsewhere. Because so much research is going on, and because many traditional educational programs take a recess in summer, the tendency may be to overlook the Institute's education component at this time of year.

As you will read in this issue of the IES Newsletter however, during the summer, students of all ages expand their scientific horizons through participation in special programs at the Institute. Highlighted here are the Research Experiences for Undergraduates program — one of our longest-running summer education efforts — and the IES Ecology Day Camp, the most recent addition to our program.

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Out of the Classroom and Into the Field: Research Experiences for Undergraduates - 1994

In 1988, the National Science Foundation (NSF) selected the Institute of Ecosystem Studies to be one of the sites for an initiative called Research Experiences for Undergraduates (REU). The goal of NSF in developing the REU program was to improve science education in the U.S. and to help assure an adequate supply of top-notch scientists, mathematicians and engineers for the future. Since the start of the REU program, many institutions across the country have competed for annual NSF funds to support students, and IES is proud to have been among the recipients for seven consecutive years.

The Institute's REU program is administered jointly by Drs. Alan R. Berkowitz, Stuart E.G. Findlay and Steward T.A. Pickett and facilitated by REU coordinator Stephanie Shoemaker in the IES Education Program office. The three-month program begins late in May. REU students function independently in collaboration with an IES ecologist, designing their own studies, doing field and laboratory research and analyzing results. In late August they present their findings at a symposium attended by Institute staff and members of the public. Research papers are published by the Institute as an IES Occasional Publication.

Research isn't the only learning opportunity the students enjoy during their summer at the Institute. At a mid-summer "Forum on Opportunities in Ecology", REU participants meet with professionals from 12 science-related fields. This program, also attended by students from nearby colleges and universities, offers an opportunity to experience vicariously the challenges and rewards of careers in academia, museum curatorship, field research, science writing, education, consulting, applied ecology, industry, city government, environmental regulation, environmental activism and environmental law.

Weekly REU seminars focus on "Research Strategies", about scientific methods, theory etc., and "Research in Context", designed to help students put their own research into the broader perspective of the discipline of ecology, the scientific community and society in general. During summer 1994, the students looked at issues relating to the New York City water supply, considering the social, economic, ethical and

political ramifications of New York state's watershed protection programs. For the past two summers, also as part of Research in Context, REU students have spent a day with at-risk high school students through the Liberty Environmental Science Academy (a joint program of Bank Street College of Education, New York City; Bard College, Annandale, N.Y.; and IES), working at field sites around the Institute.

Mellon Foundation Support

This year, 209 college undergraduates from across the country applied for the 10 REU internship positions at IES. Eight of the recipients were supported by the NSF grant. A donation to the Institute by The Andrew W. Mellon Foundation, through its Minority Undergraduate Fellowship Program, supported two additional students.

1994 REU students and their research projects were:

- Kristin K. Arend (Oberlin College, Oh.): *Feeding selectivity of larval white perch (Morone americana) and striped bass (Morone saxatilis) in the Hudson River estuary.* Dr. Michael L. Pace, mentor.
- Cynthia S. Davis (Virginia Union Univ., Va.): *The effects of biofilm on removal of dissolved organic carbon from shallow ground water.* Dr. Stuart E.G. Findlay, mentor.

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REU student Cynthia Davis

Student Science: REU 1994, *continued*

- Amanda Fuller (Denison Univ., Oh.): *A comparison of nitrogen mineralization rates for four species in the Catskill Mountains, N.Y., and White Mountains, N.H.* Drs. K.C. Weathers and G.M. Lovett, mentors.
- Emiliano V. Gaytán (Univ. of California at Davis, Ca.): *Seed bank density and distribution in the forest edge.* Dr. S.T.A. Pickett, mentor.
- Carol S. Pabin (Ohio State Univ., Oh.): *The influence of hyporheic upwelling on invertebrate drift in a small stream.* Dr. S.E.G. Findlay, mentor.
- Ellis J. Still (Rutgers Univ., N.J.): *Earthworm populations along an urban to rural gradient in schoolyard ecosystems.* Drs. Alan R. Berkowitz and Patrick J. Bohlen, mentors.
- Pamela Templer (Univ. of California at Santa Cruz, Ca.): *Uptake rates of nitrate and ammonium between red oak (*Quercus rubra*) and Norway maple (*Acer platanoides*) seedlings.* Dr. R.V. Pouyat, mentor.
- Martin M. Traynor (Univ. of Connecticut, Ct.): *Physical environmental gradients across the forest edge.* Dr. S.T.A. Pickett, mentor.
- David R. Whitall (Pennsylvania State Univ., Pa.): *Variations in dissolved organic carbon in leaf litter leachate along an urban-rural gradient.* Dr. R.V. Pouyat, mentor.
- Wendell D. Whitehead (Talladega College, Ala.): *Animal activity on the forest edge.* Dr. S.T.A. Pickett, mentor.

Summaries of selected projects:

Hudson River Ecology

A tiny crustacean called the "water flea" (*Bosmina longirostris*) is only about 0.5 millimeters long (0.02 inches), but when these animals reproduce in the Hudson River early in summer the biomass is substantial. Simultaneously, fish eggs are hatching in the Hudson River and the larval fish are starting to feed. Dr. Michael L. Pace, an aquatic ecologist at the Institute, is studying the ecology of the Hudson River and is especially interested in the relationship between zooplankton — the animals living in the planktonic community — and their consumers.

Kristin K. Arend, a junior at Oberlin College in Ohio and a 1994 IES REU student with an interest in aquatic ecology, read about Dr. Pace's research and wanted to learn more about whether or not *Bosmina* — especially during its annual peak in abundance — is a major source of food for larval fish. White perch (*Morone americana*) and striped bass (*Morone saxatilis*) are commercial and recreational



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resources as well as important components of the Hudson River ecosystem. Ms. Arend, above, studied the larval forms of these two fish species in her summer's research into feeding selectivity.

Her first challenge was learning to tell the larval fish apart. Netted in the Hudson River in June, not long after hatching, the larvae were from 3 - 10 mm long (0.12 - 0.4 in.) and the only distinguishing features were the patterns of pigment cells on the animals' abdomens and the arrangement of internal organs. (Since fish at this early stage of development are transparent, major organs are visible through the body wall.). Ms. Arend spent long hours at the microscope, first separating and counting the two species, then looking at the gut to identify what they had eaten.

After examining 360 fish, her findings were not what she had predicted. She counted an average of 1 - 5 *Bosmina* in each fish's gut, but discovered an average of 1 - 18 copepods. Copepods, members of another family of crustaceans, are larger than *Bosmina* (while still microscopic) but their population in the Hudson River is considerably smaller. In spite of this, they were clearly the preferred prey by both fish species. When asked to speculate on the reason for this, Ms. Arend said that she suspected the larger size may be an important factor.

Biofilm and DOC

As decomposition of organic material proceeds in the ecosystem, carbon and other breakdown products reach the groundwater. Mysteriously, dissolved organic carbon (DOC) is lost as it percolates through the groundwater. Where does it go? Is it lost

abiotically, through adsorption onto sediment particles? Or is the process a biotic one, through bacterial uptake? Could the agent for whatever biotic processes are occurring be the microorganisms in the "biofilm" layer that surrounds sediment particles in the groundwater system?

The question interested Dr. Stuart E.G. Findlay, an IES aquatic ecologist who was mentor to REU student **Cynthia S. Davis**. Ms. Davis, a senior at Virginia Union University in Richmond, Va., is a biology major and found a study of invisible interactions to be an interesting challenge.

At a site along the East Branch of Wappinger Creek, in the Arboretum lowlands, she collected samples of sediment and streamwater. To test whether the presence of living material in the sediment affected DOC levels, she treated one of the sediment/streamwater samples with mercuric chloride, a poison, to kill all microorganisms. Then, to learn whether or not the biofilm itself had an influence on DOC removal even when the organisms had died, she removed all traces of organic material from the sediment by incinerating it at 450°C (842°F).

After measuring DOC levels with an instrument called a total organic carbon analyzer, Ms. Davis found that the rate of DOC removal was identical in the sediment/streamwater samples with a living biofilm and the poisoned samples. When she compared the untreated samples to those that had been incinerated, however, she found that DOC removal was faster in the untreated "living" sediments. These findings suggest that the presence of biofilm, regardless of whether the organisms in it are alive or dead, facilitates the removal of DOC from groundwater through both physical adsorption and biological uptake.

Contaminants in groundwater are a major threat to our drinking water. Understanding how the soluble compounds that make up DOC are removed from water in underground aquifers would add to our knowledge of how to remediate contamination problems. Ms. Davis' work, and other related studies, help to increase this understanding.

Earthworms

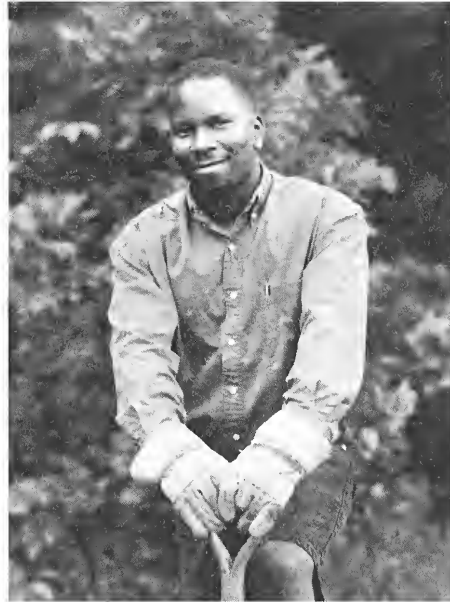
Earthworms are decomposers, eating plant and animal debris as well as soil. Ingested materials pass through the worm's digestive tract, where organic matter and soil particles are ground up by the gizzard. Some nutrients are absorbed by the intestine while the other material is excreted in the

top soil and on the soil surface. These nutrient-rich deposits, called castings, improve the soil. Also, through their tunneling behavior, earthworms help keep the layers of surface soil mixed, aerated and permeable to rainwater.

Ellis J. Still may be the first IES REU program participant to be a student of landscape architecture. His course work at Rutgers University is strong in environmental design and he applied for an REU internship to learn more about how to link landscape design with ecological principles. His project at IES, which compared schoolyard earthworm populations along an urban to rural gradient, brought him in very close touch with the landscape.

Mr. Still's goal was to extend the results of research done in 1993 by IES REU student David Steinberg, who found that earthworm activity is significantly greater in soils in urban forests than in rural forests. One of his mentors, IES head of education Dr. Alan R. Berkowitz, is directing an Institute education initiative called SYEFEST (Schoolyard Ecology for Elementary School Teachers — see IES NEWSLETTER Volume 11 No. 2). Mr. Still, Dr. Berkowitz

and soil ecologist Dr. Patrick J. Bohlen chose schoolyards as research sites, not only because they were interested in turf versus forest soils, but also because data would be relevant to ecological research projects by SYEFEST teachers and students. The selected schoolyards represented a range of



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urban to rural environments, in the Bronx and Manhattan, in Sussex County, N.J., in Dutchess County, N.Y., and in Litchfield County, Ct.

Mr. Still, left, sampled earthworms at 24 sites, digging holes 20 x 20 centimeters square and 30 centimeters deep (8 x 8 x 12 inches) and searching for the animals by hand. Worms were brought back to the laboratory for identification by Dr. Bohlen, and Mr. Still recorded information on the soils, comparing soil moisture, organic matter content and the degree of compactness. He hoped to determine the distribution of earthworms and to correlate animal density with soil characteristics.

One of the realities of science is that not all projects have a tidy ending. In contrast to the pattern seen in forest soils, there were no consistent differences in earthworm populations between urban and rural schoolyard sites. Mr. Still suggests that his methodology might be refined by a future REU student to learn what may explain why certain schoolyards — urban and rural — had many earthworms while others had very few.

Student Science: Ecology Day Camp for Elementary School Children

Cary Pond hides on the flank of one of the Cannoo Hills at the Mary Flagler Cary Arboretum. With a surface covered by tiny aquatic plants called duck weed, it has the appearance of a primordial swamp. It is home to turtles, frogs, salamanders and a tremendous variety of invertebrate animals. For many of the 75 first- to sixth-graders attending the IES Ecology Day Camp, exploring this pond was the highlight of their summer adventure at the Institute.

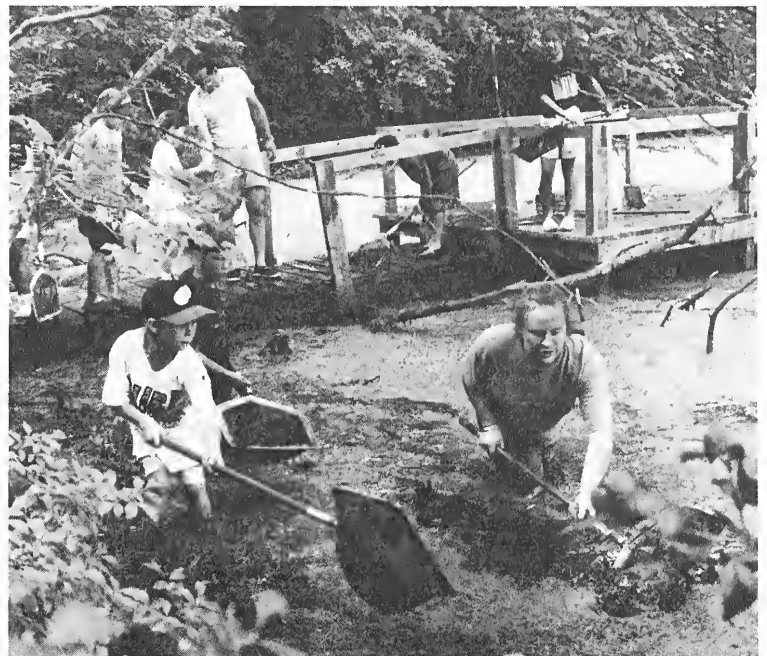
Conceived and planned by IES head of education Dr. Alan R. Berkowitz, the camp opened its first season with close to maximum enrollment. Younger campers alternated with the older ones for the seven one-week sessions. Camp educators were Jennifer Hauxwell, a May 1994 graduate of the University of Michigan with teaching certification in biology and chemistry, and Frederic Shaw, a wood sculptor and avid naturalist who currently is earning a biology degree from the State University of New York in New Paltz.

The Ecology Day Camp was based at the Institute's Carriage House. Aquaria with live pond and stream animals shared the countertops with cages of insects and other land creatures. Microscopes, books and crafts projects covered the tables, while

collecting nets and buckets were stacked in the corner. Campers worked with miniature ecosystems in the mini-ponds at the adjacent Outdoor Science Center, and, in addition to their morning at Cary Pond, traveled to Wappinger Creek, Fowler Pond and other areas on the Arboretum to study and observe.

One project that spanned the full seven weeks was the creation of a diorama. From natural materials collected during their field trips, campers made models of local animals and plants for which Mr. Shaw built a frame. The completed piece now hangs in the lobby of the IES Plant Science Building (see calendar on page 4).

Camp educator Jennifer Hauxwell led campers into the shallows of Cary Pond to collect animals and plants for observation.



JILL CADWALLADER

Calendar

CONTINUING EDUCATION

Fall semester catalogues are available from the Gifford House. Among the late fall offerings are:
Natural Science Illustration

Nov. 3 (6 sessions): **Drawing II**

Nov. 5 &/or Nov. 6: **Drawing in the Greenhouse Workshops**

Nov. 5: **Careers in Horticulture**

Nov. 15: **Particular Plants for Particular Places**
Natural Crafts

Oct. 29: **Grapevine and Bittersweet Wreath**

Nov. 5 and 19: **Pine Cone Wreath**

Nov. 12: **Victorian Tree Centerpiece**

Dec. 3: **Cranberry Wreath**

Dec. 3: **Outdoor Holiday Wreath**

Dec. 17: **Fresh Holiday Arrangement**

Call 914/677-9643 for information on certificate programs or individual offerings, or to register.

Winter/Spring semester catalogues will be available early in December.

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted.

Last-minute schedule changes are sometimes unavoidable, so call 914/677-5359 to confirm the day's topic:

Nov. 6: **Tour of the Institute's Laboratories**, led by Dr. Kathleen Weathers

Nov. 20: **Fish of the Hudson River**, a slide talk by Dr. Karin Limburg

Dec. 4: **An Origami "Lowlands Ecosystem"**, an activity for age 8 - adult, led by Jill Cadwallader

• In case of poor weather, call 677-5358 after 1 p.m. to learn the status of the day's program.

ESPECIALLY FOR CHILDREN

- **Ecosystem Diorama**, made by children of the 1994 IES Ecology Day Camp, on display in the lobby of the Plant Science Building. Weekdays, 9 a.m. - 4 p.m., through December. Free.
- **Ecology of a Christmas Tree**, a mini-adventure for children and their escorts, led by Mike Weintraub. 2 - 3 p.m. on December 17. Meet at the Gifford House. Dress for the weather. Free.
- **Plant Power in the Greenhouse**. Coming soon !!

IES SEMINARS

The Institute's program of scientific seminars features presentations by visiting scientists. Free seminars are held each Friday at 3:30 p.m. in the IES Auditorium.

Nov. 4: **The Effects of Eutrophication on Higher Trophic Level Production in Estuaries**,

Dr. Linda A. Deegan, The Ecosystems Center, Ma.

Nov. 11: **Potential Impacts of Zebra Mussels (*Dreissena polymorpha*) in New York Waters: Case Studies of the Seneca River and Lake Champlain**, Dr. Clifford Siegfried, New York State Museum

Nov. 18: **Characterizing Controls on Forest N Retention Using Large-scale ¹⁵N Additions**, Dr. Knute Nadelhoffer, The Ecosystems Center, Mass.

Dec. 2: **Forest-Atmosphere Water Vapor and CO₂ Fluxes in Siberia**, Dr. David Hollinger, USDA Forest Service, Durham, N.H.

Dec. 9: **Memory and Sense of Place in Southern Culture**, Dr. William R. Ferris, Center for the Study of Southern Culture, Univ. of Mississippi

Dec. 14 (Wednesday): **The Solar Bottleneck Hypothesis: Conflicting Selective Pressures in Natural Zooplankton Communities**, Dr. Craig Williamson, Lehigh Univ., Pa.

Seminars begin again in mid-January.

GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 4:00 p.m. daily except public holidays. Admission is by free permit (see below).

IES GIFT AND PLANT SHOP

New in the Shop!! ... for children ... "Bandana Games": *Nature Quest*, *Bug Bingo* and *ABC Discovery*; "See for Yourself" science experiment kits; ... and, for all ages ... 1995 nature and gardening calendars; hand-carved ironwood animals
Senior Citizens Days: 10% off on Wednesdays

HOURS

Winter hours: October 1 - April 30

Closed on public holidays.

Public attractions are open Mon. - Sat., 9 a.m. - 4 p.m. & Sun. 1 - 4 p.m.

The IES Gift and Plant Shop is open Mon.- Sat., 11 a.m. - 4 p.m. & Sun. 1 - 4 p.m. (The shop is closed weekdays from 1 - 1:30 p.m.)

• All visitors must pick up a free permit at the Gifford House Visitor and Education Center on Route 44A for access to IES public attractions. Permits are available until 3 p.m. daily.

MEMBERSHIP

Become a member of the Institute of Ecosystem Studies. Benefits include a member's rate for IES courses and excursions, a 10% discount on Gift Shop purchases, a free subscription to the IES Newsletter, and participation in a reciprocal admissions program, with benefits at over 100 nature centers, forest preserves, gardens and conservatories in the U.S. and Canada. Individual membership is \$30; family membership is \$40. For information on memberships, call Ms. Janice Claiborne at 914/677-5343.

For general information, call the IES Education Program Office at the Gifford House Visitor and Education Center: 914/677-5359 weekdays from 8:30 - 4:30.

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